

A FIRST RECORD OF *OCTOPUS MACROPUS* RISSO FROM
THE UNITED STATES WITH NOTES ON ITS BEHAVIOR,
COLOR, FEEDING AND GONADS¹

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INTRODUCTION

On December 19, 1955 Mr. Robert Still, a Miami shrimp fisherman, brought to the Miami Seaquarium a "red octopus with white spots" which he had taken in a shrimp trawl off Key Biscayne, Florida. The octopus was placed in an aquarium and held alive for a period of five months during which time its feeding habits, behavior, color patterns and other points of interest were observed by one of us (Phillips). At the time of capture the other author (Voss) was called to the Seaquarium to identify the octopus and at that time color notes, skin sculpture, and other features were observed. After a preliminary examination, the animal was considered to be an *Octopus macropus* Risso, the first specimen taken from the continental waters of the United States.

At the end of a short period of refusing to take food and an abnormal growth of the mantle, the animal died and it was turned over to The Marine Laboratory where one of us (Voss) made the positive identification and studied the specimen in detail. The following observations are a result of a combined effort by the authors to contribute to the biology and knowledge of this species upon which very little has been written.

The present paper had been finished when a second specimen, UMML Cat. No. 31.95, was turned over by the Seaquarium to the Marine Laboratory for study. The measurements and indices of this specimen, a male, have been incorporated in Tables 1 and 2 and pertinent information added where possible.

SYSTEMATICS AND DISTRIBUTION

Octopus macropus has been thoroughly dealt with systematically by two writers, Robson (1929) and Pickford (1945). These authors

¹ Contribution No. 203 from The Marine Laboratory, University of Miami.

have described the general appearance and the former the distribution of the species, stating that it had a world wide range with the exception of the Americas. The latter author listed the species from various points in the Western Atlantic, notably Rio de Janeiro, Barbados, the Caribbean, Haiti and Bermuda.

The present specimen is the first record of this species from the continental waters of the United States, thus including the mainland in its range. The collector, Mr. Still, reported that he had taken another specimen from the same area the year before (1954) and thus it appears that it is a regular inhabitant of our coast. It is interesting to note, however, that both of the authors have collected extensively throughout the southeast coast of Florida and have not met this species in the shallow waters commonly occupied by *O. briareus*, *O. vulgaris* and *O. joubini*. The fact that *O. macropus* was taken in a shrimp trawl on both occasions points to a deeper habitat on our coast, probably 35-50 feet, the normal depth of shrimp trawling.

Besides the female specimen, UMML Cat. No. 31.73, seven other specimens of this species are in the collections, five from Cotton Cay, Cay Sal Bank, UMML 31.29, and two adults from Bimini, Bahamas and several immature and post-larval specimens from the Bahamas collected from fish stomach contents. Unless *O. verrilli* var. *palliat*a Verrill from the Bahamas is *O. macropus*, as suspected by Pickford (1946) these are also the first records of this species from the Bahamas.

Table 1 gives the measurements of the Florida specimens and Table 2 gives the calculated indices as defined by Pickford (1945).

The arms are incomplete in the female but the male has the normal *O. macropus* arm order of 1.2.3.4. The web depth index is low, 12.7 and 11.1, slightly lower than that given by Pickford for the Bermuda specimen. A comparison of the other data with those given by Pickford are as follows. The MWI is comparable and is very variable in this species, but the head width index is very low in the female, 26.6 compared with Pickford's lowest of 32.5. The narrow head was striking in life as well as later when the specimen was preserved. The sucker index is low in the female, 6.9 as against 8.4, the lowest given by Pickford and that of the male is normal. The arm length is approximately the same but the mantle arm index is high in the female, 36.0 to Pickford's 25.5. The width arm index of 10.4 is also low in the female. Certain of these vari-

TABLE 1

MEASUREMENTS (IN MM) OF TWO SPECIMENS OF *OCTOPUS MACROPUS* RISSO FROM OFF BISCAYNE BAY, FLORIDA

| Sex | Female | Male | | Female | Male |
|--------------|--------|-------|-------------------|--------|-------|
| TL | 826.0 | 678.0 | Arms I | 624.0 | 583.0 |
| ML | 173.0 | 90.0 | II | 450.0— | 526.0 |
| MW | 95.0 | 62.0 | III | 245.0 | 280.0 |
| Web Sector A | 79.0 | 52.0 | IV | 516.0 | 435.0 |
| B | 77.0 | 55.0 | Sucker Diam. | 12.0 | 10.0 |
| C | 57.0 | 65.0 | No. gill lamellae | 12 | 12 |
| D | 53.0 | 63.0 | Arm width | 18.0 | 16.0 |
| E | 43.0 | 56.0 | | | |

TABLE 2

BODILY PROPORTIONS, SUCKERS, GILLS, ARMS AND WEB OF *OCTOPUS MACROPUS* RISSO

| Sex | Female | Male | | Female | Male |
|-------|--------|------|------------|--------|-------|
| ML | 173.0 | 90.0 | Arm length | 624.0 | 583.0 |
| MWI | 54.8 | 69.0 | ALI | 75.5 | 86.0 |
| HWI | 26.6 | 53.3 | MAI | 36.6 | 15.4 |
| SIn. | 6.9 | 11.1 | AWI | 10.4 | 17.8 |
| Gills | 12 | 12 | WDI | 12.7 | 11.1 |

TABLE 3

CHARACTERISTICS OF HECTOCOTYLUS AND PENIS OF A MALE SPECIMEN OF *OCTOPUS MACROPUS* RISSO FROM OFF BISCAYNE BAY, FLORIDA

| | | | |
|------|-------|--------|------|
| ML | 90.0 | L.L.I. | 6.8 |
| H.A. | 280.0 | C.L.I. | 13.2 |
| Lig. | 19.0 | P.L.I. | 12.0 |

ations in indices, especially those concerned with the mantle, are probably due to the elongation and inflation of this part of the specimen.

The male characteristics all vary from those listed by Pickford. The L.L.I. is higher and the C.L.I. and P.L.I. are lower. It is hoped that more specimens will be forthcoming from the Florida area.

In general, the body was long and distinctly oval, somewhat pointed posteriorly. The skin appeared smooth over the general surface and no bosses over the eyes were noted such as Pickford observed for other American specimens, and none were noticeable after death. However, during certain color phases as described later, large low ridge-like papillae appeared in a few rows along the dorsum of the mantle. A noticeable skin fold appeared on occasions extending along the dorso-lateral margins of each arm. Both of us noticed especially the long narrow pointed funnel which extended well beyond the level of the eyes.

GENERAL BIOLOGY

Behavior. Upon receipt at the Seaquarium the octopus was immediately moved for observation to a large open concrete holding tank. As the animal was experiencing difficulty in swimming and crawling from a quantity of air trapped within the mantle cavity, a certain amount of this was removed by holding the octopus underwater by the mantle with the funnel uppermost and massaging the body. All of the air could not be removed in this manner and it was not until the following morning that the octopus was seen to be free of all remaining air.

During the time that it was held free in the holding tank the animal alternately swam back and forth in the tank and rested at the bottom. As it was feared that it might escape while the exhibition tank was being prepared, it was held for two or three days in a heavy wire cage sunk at the bottom of the tank. During this period a considerable part of one of its arms disappeared and since there were no other marine animals in the tank it was assumed that this was eaten by the octopus itself.

An examination of the tips of the arms after death showed little evidence of regeneration even after a period of five months had elapsed. The end of the third right arm which had healed in normal fashion had a minute bud on the outer part about 1.0 mm in

length. The second left arm had also healed over but one sucker had assumed a directly terminal position and there was no evidence of regeneration. The end of the first left arm had apparently only recently been broken or eaten and healing had not as yet occurred.

Several days after capture the animal was moved to a glass-fronted, 350 gallon fiberglass exhibiton tank at the Seaquarium, where it remained until the time of its death, five months later. The tank was lighted during the day by three large fluorescent tubes (a combination of daylight and cool white) and a wire mesh screen was secured over the top to prevent escape. Other specimens in the tank included from time to time small specimens of *O. briareus* and about 12 small moray eels of the genera *Gymnothorax* and *Echidna*.

In its movements the specimen was seen to be less active than either *O. vulgaris* or *O. briareus*, a number of which had been kept from time to time under similar conditions. This included not only locomotion, but also respiration. When resting, the animal usually kept its arms bunched beneath it, showing a lesser tendency to coil them in an upward spiral than is common in the other two species. When touched, it usually responded by radiating all of its arms outward along the substrate in a creeping movement tips first, like the spokes of a wheel. Further stimulation usually induced it to swim through the water in normal octopus fashion, though more slowly, with the arms trailing behind it. Though the specimen was deliberately stimulated by hand in an effort to induce it to eject ink, results were completely negative.

The eyes had bar-shaped pupils which were usually dilated when active but when at rest the pupils were contracted to mere slits or completely closed in the center leaving minute apertures visible at either end.

During the day the octopus showed very little activity, spending most of its time on top of an eroded coral rock in the center of the floor of the tank, but it was seen to move about at night and during the early morning hours. The lights over the tanks were extinguished each night at 10:00 p.m. and turned on again at 8:00 a.m. In the early morning hours the octopus would often be seen moving about in the tank but as soon as the lights came on it would promptly come to rest atop the large rock or in one of the rock lined corners of the tank.

As mentioned above, there were other inhabitants of the tank.

It is interesting to note that the octopus paid little attention to the presence of the small moray eels, a normally important predator upon octopods. Should one of them approach too closely, it merely fended it off with one of its arms. It is possible that only large moray eels are predators on octopods and that no reaction was forthcoming from small ones although apparently inherent reactions occur among other animals on contact. An apparent instinctive reaction between the common squid, *Loligo pealei* held in a tank at the Shellfish Laboratory at Woods Hole and the blue crab, *Callinectes sapidus*, was observed by one of us (Voss). The crabs occasionally would catch a squid by the mantle in their claws. Contrary to expectation, the squid did not struggle but swept its tentacular suckers lightly over the crab's carapace, upon which the crab would release the squid instantly and scurry off. It is impossible to say whether this is an inherited reflex action caused by their hereditary enemy or due to some other cause.

The presence of the small octopuses caused a slightly greater negative response or retreat, but they in turn were highly disinclined to invade the territory of the octopus. No fighting or other direct interplay of action between these two species was noted, as in general they kept strictly out of each other's way.

About two months before its death, the specimen was seen to have acquired two superficial injuries over one eye. This was thought to have been caused by one of the morays, but the injury healed uneventfully and did not recur, despite the fact that the eels remained in the tank with the octopus.

During the first week in May it was reported by the tank attendants that the octopus apparently had not fed for several days since no fresh shrimp or crab shells had been found in the tank during that time. A close examination of the octopus showed it to be more sluggish in its movements than usual while its breathing was more labored and rapid than usual. Prodding it caused but little brightening in color pattern. Since the body appeared somewhat swollen it was thought that the animal was preparing to spawn, or else that it might have been overfed.

For another week and a half the apparent fasting continued and the body became more swollen. Movements, except for the accelerated breathing became very sluggish and the body hue gradually assumed a lifeless gray, and at this time a pathological condition was evident.

On the morning of May 13 the octopus was found dead by a tank attendant who, following prior orders, removed the specimen and placed it on a shelf in the aquarium freezer room. Later it was preserved and turned over to The Marine Laboratory Marine Museum for further study. The second specimen was not observed as closely but it also was secretive and nocturnal in behavior.

Habitat. Little is known about the habitat preferences of this species. According to Robson (1929), who cites various sources, it lives in the Mediterranean on rocky shores or on both rocky and sandy bottom. Pickford (1947), who studied the species in the Western Atlantic, states that the common octopus, *O. vulgaris*, is called the "Rock Scuttle" in Bermuda while *O. macropus* is called the "Grass Scuttle," but she draws no inference as to habitat from this.

The present specimen, coming from a shrimp trawl off Key Biscayne was almost positively living on soft mud and *Thalassia* or turtle grass bottom. The specimens from Cotton Cay, Cay Sal and the Bahamas had no habitat data included but from an account of the collecting they probably also came from shallow water *Thalassia* beds near shore. The second specimen was taken off lower Biscayne Bay in grass bed areas:

Food and Feeding. During its life in captivity, the octopus was never seen to feed and this probably took place at night. The tank was kept supplied with a number of shrimp, *Penaeus*, and small crabs, *Callinectes*, and the cleaned out shells of these were observed on the floor of the tank in the morning. By way of contrast, specimens of *O. vulgaris*, *O. briareus* and *O. joubini* kept in tanks at the aquarium all accepted live food quite readily in the daytime. No other food was given the animal while in the tank. There are apparently no observations in the literature on food or feeding of this species.

Color. Shortly after capture when seen by both of us in the holding tank the color varied from brick-red to pinkish-orange marked with a profusion of large white spots about one-half inch in greatest diameter on the mantle, head and arms, extending outwards on the latter to the tips. When at rest the spots faded out and became indistinct but returned when the animal was disturbed. After a month or two in the tank the original pinkish-orange and brick-red dulled to a dark red-brown, though the white spots still showed

very boldly when the octopus was active. When fully quiescent, the mantle assumed a drab brownish gray color against which the spots escaped notice under all but the closest scrutiny. The iris of the eyes remained a dull yellow. The same coloration and patterns were observed in the second specimen which had even more regular light spots.

Internal Condition of the Mantle. When the specimen was brought into the laboratory for examination it was found to have a greatly distended mantle. On the dissection table the specimen was cut open with a pair of scissors. At the upper $\frac{1}{4}$ of the mantle the scissors met with an obstruction from a membrane and when this was punctured a large volume of discolored and vile smelling liquid was released, accompanied by large numbers of small eggs about 3 mm long and 1 mm wide. When the mantle cavity was laid open (Figure 1) it was found that the ovarium was greatly enlarged, occupying over $\frac{3}{4}$ of the mantle cavity and was now filled with a large number of decomposing eggs but still containing a solid mass of eggs about 60 mm in diameter.

In the process of distending the mantle, the viscera had been pressed together anteriorly until the same organs that normally occupy about $\frac{3}{4}$ of the mantle cavity now were contained in a restricted layer about 8 mm in thickness. In the same process, the membrane surrounding the ovaries had been pressed against the interior mantle wall until it had fused with the mantle wall throughout the posterior $\frac{3}{4}$ of the mantle and combining laterally with the membrane surrounding the viscera had formed

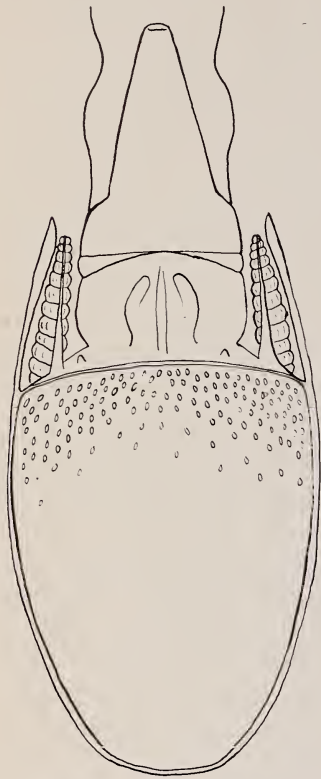


Figure 1. Semidiagrammatic illustration of the mantle cavity of the female *Octopus macropus* Risso from off Biscayne Bay, Florida. The transverse septum is prominent, but only a few of the eggs have been shown.

process, the membrane surrounding the ovaries had been pressed against the interior mantle wall until it had fused with the mantle wall throughout the posterior $\frac{3}{4}$ of the mantle and combining laterally with the membrane surrounding the viscera had formed

a thick, tough septum separating the ovaries from the exterior. An examination in detail of the posterior surface of the septum failed to reveal any trace of the gonoducts, and it is considered by the authors that the posterior or inner ends of the gonoducts had fused, thereby preventing the eggs from leaving the ovary and indeed sealing the latter organ with its developing eggs completely off from the external medium.

Even in non-copulating females the eggs, unfertilized, are laid in aquaria, though all soon decompose. In the present case it seems that death resulted from perhaps two causes. (1) the toxic effect of the decomposing eggs sealed within the mantle and (2) the extreme displacement of the internal organs. It is commonly reported that spawning female octopuses refuse food. While the present condition as described above is probably extreme, a squeezing together of the internal organs and displacement of the stomach may account for the inability to feed during this period and is seen in many other invertebrates.

Naef (1923 : 685) has shown a somewhat similar situation in a lesser degree in a Mediterranean *O. vulgaris*. He writes, "Reifes weibe vor der Eiablage, mit prall gefüllten ungeheuer vergrößerten Ovarium, durch das die übrigen Orange stark Bedrängt werden. Diese sind in möglichst natürlichen Lage dargestellt, doch ist der Mantelsack leider stark geschrumpft, so dass der ganze Abdominal-situs gegen dem Ausgang gequetscht wird. Man dencke sich dem Mantlesack hier immerhin wesentlich geräumiger und vergleich die vorhandene Figur." And on page 686, "Vor allem aber hat das Ovarium einen ausserordentlichen Umfang erreicht und enthält etwa hunderttausend Eier (*O. vulgaris*). Dadurch wird die Topographie der Mantelhöhle stark gestört, wie die Fig. p. 685 zeigt. (Darin verhalten sich andere Octopodidae ganz gleich)."

Numerous other spawning females have been seen by the authors and one of us examined a good many in detail and no similar condition of the mantle has been seen. It is considered that this was probably a rare and pathologic condition and resulted in the death of the present specimen.

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RESEARCH NOTE

Additions to the Fishes Known from the Vicinity of Cedar Key, Florida

Two species of the family Carangidae are added to the list of fishes known from the vicinity of Cedar Key, Florida (Reid, 1954, *Bull. Mar. Sci. Gulf & Caribb.*, 4(1) : 1-94. Caldwell, 1954, *Quart. Journ. Fla. Acad. Sci.*, 17(3) : 182-184. Caldwell, 1955, *Ibid.*, 18(1) : 48. Caldwell, 1957, *Ibid.*, 20(2) : 126-128. Kilby, 1955, *Tulane Stud. Zool.*, 2(8) : 175-247). These specimens are in the collections of the U. S. Fish and Wildlife Service's South Atlantic Fishery Investigations at Brunswick, Georgia.

Caranx ruber (Bloch). Jack crevalle or green jack. Two specimens, 129 and 137 mm. in standard length, were taken by the U. S. Fish and Wildlife Service M/V *Silver Bay*, Station 152, 29°01' N., 83°21' W., approximately 11 miles southwest of Cedar Key, August 21, 1957. This species has only rarely been reported from the northern Gulf of Mexico (Berry, MS, *Fish. Bull. Fish & Wildl. Serv.*).

Seriola dumerili (Risso). Great amberjack. One specimen, 150 mm. in standard length, was taken at *Silver Bay* Station 152 (data as above). Another, 250 mm. in standard length, was caught at Seahorse Reef, October 12, 1957, by Dr. E. Lowe Pierce, University of Florida. These identifications are based on the descriptions of Ginsburg (1952, *Pub. Inst. Mar. Sci.*, 2(2) : 43-117). The nuchal band is vaguely visible on the 150-mm. specimen and extends from over the eye to the origin of the first dorsal fin; but it is not present on the 250-mm. specimen. The great amberjack is relatively common in the Gulf of Mexico, and visual accounts of amberjacks of over six feet in total length are probably attributable to this species.—Frederick H. Berry, U. S. Fish and Wildlife Service, Brunswick, Ga.

Quart. Journ. Fla. Acad. Sci., 20(4), 1957.